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THE EFFECT OF HYPOXIA EXERCISES ON ARTERIAL BLOOD GASES PARAMETERS FOR FUTSAL PLAYERS

Mustafa Ghasib Abdulzahra[i],
Muthana Layth Hatem
Asst. Prof. Dr.,
College of Physical Education and Sports Science,
University of Misan,
Iraq

Abstract:
The study aimed to find out the effect of fitness exercises according to the method of gradient lack of oxygen on the parameters of arterial blood gases for futsal players. The researchers determined their research community in a deliberate way, namely the players of Maysan Sports Futsal Club in Maysan Governorate, the category of applicants over the age of (20) years, and registered with the lists of the Football Sub-Federation for the sports season (2022-2023), which numbered (26) players. The researchers concluded the following Fitness exercises according to the gradient method affected the lack of Oxygen has a significant effect on the parameters of arterial blood gases, in the regulation balance (pH), raising the level of gas pressure (pO2) and the level of (Hco3), and inhibiting the level of gas pressure (pCO2) in the blood, and the preference was for the experimental group compared to the control group.

Keywords: hypoxia exercises, arterial blood gases

1. Definition of the Research

1.1 Introduction and Importance of the Research

Recent studies have relied on scientific innovations in the field of sports technology, from providing innovative scientific means with better effectiveness that affected various physical activities and employing them appropriately and accurately during the implementation of training programs to create the desired impact on athletes and raise the level of their achievements.

Here, it has become necessary to diversify the means and methods of training and mix them, accompanied by effective and influential exercises consistent with the nature of the muscular work carried out in achieving the desired goals, to improve public and private fitness, in light of the economy of time and effort for the training process during

[i] Correspondence: email mustafafencing@uomisan.edu.iq

the preparation and preparation of athletes for competitions, and the method of training hypoxia using the means of training mask is one of the effective methods To control the amount of oxygen, this puts tissues and muscle cells working with exceptional effort under different conditions represented in the lack of oxygen available to them, which makes them in front of great pressures due to the implementation of the formed training loads, leaving a degree of oxygen deficit shed on them, to cause changes in the overall functions of the individual organic, including arterial blood gases, which play a vital role and this deficit during the exercise of physical efforts with hypoxia.

From the foregoing, the importance of our research in shedding light on the body's biochemical responses has emerged, due to the formation of fitness exercise loads carried out in the hypoxic method and the adoption of the mask as an auxiliary training method, which we find one of the appropriate means for the training of futsal players, and the exercises may be positively reflected in the improvement of the parameters of arterial blood gases, as it is a worthwhile phenomenon and the extent to which it is used to employ its results in raising the level of achievement.

1.2 Research Problem

Most of the previous studies focused on the use of the hypoxic training method and its functional returns, which focused on the circulatory and respiratory systems, so there is a need for more information that has not been researched, such as arterial blood gases, and the responses that accompany the adaptation process in fitness training for futsal players, which put the researchers in front of a question related to the phenomenon to provide the most accurate data that are not available and that can be used to serve in its final outcome to raise the level of achievement, due to the lack of our mathematical libraries of scientific sources explain such a research phenomenon.

- What are the levels of change in the parameters of arterial blood gases due to the effect of hypoxic training?

1.3 Research Objective

- Knowing the effect of fitness exercises according to the method of gradient lack of oxygen in the parameters of arterial blood gases (pH, O2, CO2, Hco3) for futsal players.

1.4 Imposition of the Search

- Fitness exercises according to the method of gradient lack of oxygen affect the parameters of arterial blood gases (pH, O2, CO2, Hco3) for futsal players.

2. Research Methodology and Field Procedures

2.1 Research Methodology

The researchers adopted the experimental approach for its suitability and the nature of the research phenomenon to be studied.

2.2 Research Community

The researchers identified their research community in a deliberate way, which are the players of Maysan Sports Futsal Club in Maysan Governorate, the category of applicants over the age of (20) years, and those registered with the lists of the Football Sub-Federation for the sports season (2022-2023), which numbered (26) players.

In order to obtain a sample characterized by accurate scientific specifications needed by the researchers in the implementation of their research procedures, they subjected the research community to clinical examination and conducted some analyzes by specialized health staff to ensure that the players were free of any health problems that may affect the results of the study, and the researchers also took into account the homogeneity element of the sample members for the following variables (height - body mass - chronological age - training age) as well as the equivalence of the study variables, which include (pH, O2, CO2, Hco3), and it was found that there is clear homogeneity and equivalence in these variables.

2.3 Field Procedures for Research

2.3.1 Arterial Blood Withdrawal Procedures

After obtaining all the original approvals from Maysan Sports Futsal Club, and the members of the research sample learned about the importance of the study and the extent of benefiting from it, they expressed their agreement to cooperate with the researchers and implement their research procedures, and after completing all preliminary procedures, starting with the results of the clinical examination and laboratory analysis, which resulted in the safety of the sample and their enjoyment of complete health, the researchers started from Sunday, 30/1/2022 at four o'clock in the afternoon and at Physiology Laboratory at the Faculty of Physical Education and Sports Sciences, Maysan University, by conducting an analysis of arterial blood gas parameters by a specialized laboratory staff, as samples (1 milliliter) of blood were drawn from the femoral artery by medical syringes size (3 ml), after the player lies on a medical bed and sterilizes the femoral artery area with alcohol The arterial blood was withdrawn at rest without exerting any physical effort, after which the drawn blood is placed in the place designated for the cassette placed with the (EPOC) device) for measuring the concentrations of arterial blood gases, after the device is fed with the required data such as height, age, body mass and the name of the examinee, to obtain the results of the parameters of arterial blood gases, and then the members of the research sample of the control and experimental groups performed an anaerobic physical effort on the moving treadmill where the speed of the device was (14 km/time) and a degree of inclination (11), and immediately after the effort, the procedures that preceded the physical effort themselves were performed in repeating the analysis of arterial blood gases to obtain parameters Study (pH, O2, CO2, Hco3).

2.3.2 Main Experience

After conducting the blood draw for the prior measurements of arterial blood gases, the members of the research sample were exposed to the doses of training loads for fitness exercises prepared by the researchers, as the duration of the application of the exercises reached (12) weeks and by three training units per week for the days (Saturday, Monday, Wednesday) with a total of (36) training units from 5/2/2022 to 27/4/2022, and the proposed exercises aimed to: Improvement of arterial blood gases, and commensurate in their content and the nature of the special training stage and according to the principle of the privacy of the training elements, and was gradually increased by increasing the intensity of the load and the use of tools and assistive devices that correspond to the nature of the players taking into account the differences between them, and after the implementation of the prescribed period of time from the application of fitness exercises, the blood draw was performed for dimensional measurements of arterial blood gases and under the same conditions on Friday, 30/4/2022 at four o'clock in the afternoon.

2.4 Statistical Treatments

The researchers used the statistical bag (SPSS) version (23).

3. Presentation and Discussion of Results

3.1 Presentation of Results Measurements (pH, O2, CO2, Hco3)

Table 1: The arithmetic means, standard deviations, calculated (T) value, significance level and significance of differences in measurements of (pH, O2, CO2, Hco3) before and after the effort before the program for the control group

Statistical Treatments Variables	Before the effort		Before the effort		Calculated T value	Sig	Significance of differences
	Going to	± on	Going to	± on			
pH	7.38	0.02	7.32	0.01	7.71	0.000	Moral
O2	97.81	0.42	96.98	0.38	9.36	0.000	Moral
CO2	35.53	0.32	44.87	0.83	29.16	0.000	Moral
Hco3	21.65	0.82	25.32	0.87	9.66	0.000	Moral

Table 2: The arithmetic means, standard deviations, calculated (T) value, significance level and significance of differences in measurements (pH, O2, CO2, Hco3) before and after the effort after the program for the control group

Statistical Treatments Variables	Before the effort		Before the effort		Calculated T value	Sig	Significance of differences
	Going to	± on	Going to	± on			
pH	7.37	0.03	7.30	0.04	2.98	0.020	Moral
O2	97.82	0.29	97.31	0.21	6.49	0.000	Moral
CO2	35.51	0.28	44.43	0.62	33.08	0.000	Moral
Hco3	21.37	0.91	25.20	0.84	10.34	0.000	Moral

Table 3: The arithmetic means, standard deviations, calculated T value, significance level and significant differences in measurements of (pH, O2, CO2, Hco3) before and after the effort before the program for the experimental group

Statistical Treatments Variables	Before the effort		Before the effort		Calculated T value	Sig	Significance of differences
	Going to	± on	Going to	± on			
pH	7.39	0.02	7.31	0.02	12.55	0.000	Moral
O2	97.67	0.14	96.96	0.29	6.42	0.000	Moral
CO2	35.57	0.27	44.91	0.79	27.97	0.000	Moral
Hco3	21.97	0.73	25.53	0.80	8.14	0.000	Moral

Table 4: The arithmetic means, standard deviations, calculated T value, significance level and significance of differences in measurements of (pH, O2, CO2, Hco3) before and after the effort after the program for the experimental group

Statistical Treatments Variables	Before the effort		Before the effort		Calculated T value	Sig	Significance of differences
	Going to	± on	Going to	± on			
pH	7.37	0.03	7.36	0.03	4.96	0.002	Moral
O2	98.15	0.32	97.90	0.21	3.11	0.017	Moral
CO2	53.48	0.31	41.97	1.05	15.40	0.000	Moral
Hco3	21.45	0.89	23.77	0.89	4.58	0.003	Moral

Table 5: The arithmetic means, standard deviations, calculated T value, significance level and significant differences in measurements of (pH, O2, CO2, Hco3) after the effort before and after the program for the control group

Statistical Treatments Variables	After the effort		After the effort		Calculated T value	Sig	Significance of differences
	Going to	± on	Going to	± on			
pH	7.32	0.01	7.30	0.04	0.91	0.000	Moral
O2	96.98	0.38	97.31	0.21	3.30	0.009	Moral
CO2	44.87	0.83	44.43	0.62	2.49	0.041	Moral
Hco3	25.32	0.87	25.20	0.84	1.78	0.118	Moral

Table 6: The arithmetic means, standard deviations, calculated T value, significance level and significance of differences in measurements of (pH, O2, CO2, Hco3) after the effort before and after the program for the experimental group

Statistical Treatments Variables	After the effort		After the effort		Calculated T value	Sig	Significance of differences
	Going to	± on	Going to	± on			
pH	7.31	0.02	7.36	0.03	4.42	0.003	Moral
O2	96.96	0.29	97.87	0.22	5.16	0.000	Moral
CO2	44.91	0.79	41.97	1.05	6.56	0.000	Moral
Hco3	25.53	0.80	23.77	0.89	4.58	0.003	Moral

Table 7: The arithmetic means, standard deviations, calculated T value, significance level and significant differences in measurements of (pH, O2, CO2, Hco3) after the effort after the program for the control and experimental groups

Statistical Treatments Variables	After the effort		After the effort		Calculated T value	Sig	Significance of differences
	Going to	± on	Going to	± on			
pH	7.30	0.04	7.36	0.03	2.82	0.013	Moral
O2	97.31	0.21	97.87	0.22	5.16	0.000	Moral
CO2	44.37	0.74	41.72	1.0	5.97	0.000	Moral
Hco3	25.20	0.84	23.77	0.89	3.23	0.006	Moral

3.2 Discussion of Arterial Blood Gases Measurements (pH, O2, CO2, Hco3)

Tables (1), (2), (3), (4), (5) and (6) showed the results of special statistical treatments to measure the level of parameters of arterial blood gases (pH, O2, CO2, Hco3) before and after physical exertion before the implementation of the exercise load according to the hypoxia method proposed within the general program, and it was clear from this that there are significant differences in measurements after physical exertion, as shown by tables (7)) The results of special statistical treatments to measure the level of parameters of arterial blood gases (pH, O2, CO2, Hco3) after physical exertion after the implementation of the exercise load according to the hypoxic method proposed within the general program, and it was clear from this that there were significant differences in the dimensional measurements of both control and experimental groups, but the likelihood of the differences was recorded in favor of the experimental group.

The researchers believe that the nature of the formation of the load of fitness exercises carried out by following the method of lack of oxygen practiced using the means of training mask, which would increase the physical burden on the successive and repeated muscle contractions as a result of the exceptional load effort, and this work requires the receipt of large amounts of oxygen to compensate for the amount of deficiency in tissues and muscle cells and its inevitable need for energy requirements, which affected up and down in arterial blood gases, which was reflected in pH values, and the explanation was consistent with all previous studies: "*changes occur in pH values, partial oxygen pressure (pO2) and arterial carbon dioxide (pCO2) during hypoxia exercise*." (Burton, 2004) & (Lee M, 2006) & (Wetter TJ, 2001) and also "*arterial oxygen saturation rises above 97% during the wearing of a training mask due to high hematocrit*" (Susan R. 2021) & (Connor J. 2021).

The researchers also believe that the hypoxia method is characterized by maximum intensity and below the maximum and lasts for short periods, and in light of that, the products of pyruvate glycolysis occur, leaving lactic acid in the muscles and blood, which makes the rate of acid accumulation greater than the rate of disposal in the blood, so it loses neutrality in pH and turns acidic when the lactic threshold is exceeded, so arterial blood gases are affected after physical exertion with a lack of oxygenation, and this was consistent with all previous studies: "*when the exercise is performed above the hypoxic compensation threshold, the volume of ventilation becomes proportional to the volume of* *carbon dioxide (pCO2) to inhibit blood acidity and the overproduction and accumulation of lactic acid*" (Phillips, 2020) & (Jesse C. 2020) & (Linossier MT, 2000).

Here, the researchers explain the impact of arterial blood gases by the effect of the accompanying hypoxia method through the application of fitness exercises as mentioned above, here the process of compensatory hyperventilation occurs to raise the level of pressure of pO2) gas significantly in the blood, and to achieve two basic and important factors, namely reducing the level of carbon dioxide (pCO2) dissolved in the blood, in addition to the ability of the body's organs and organs to get rid of the rate of accumulation of lactic acid, and the interpretation was consistent with all previous studies "*occurs during intense exercise hypoxia increases the demand for rapid breathing, causing changes in gases dissolved in blood, oxygen (O2) and carbon dioxide (CO2)*." (Faisal, 2015) & (Henning Bay Nielsen, 2003) & (Xing-Guo Sun, 2001) and also "*the decrease in (O2) does not pass without compensation and excessive ventilation response in hypoxia and here arterial saturation occurs and thus leads to pH equalization*." (Marconi C, 2008) & (Dominelli PB, 2020) & (Jack A, 2008) and also "*increased ventilation rate leads to reduced concentrations of carbon dioxide and lactic acid in the blood*" (Peter I. 2008).

As a result, the rate of inhalation and exhalation processes in gas exchange leads to the reorganization of hydrogen ions (pH in the blood and the maintenance of the balance between basic and acid in light of the rate of adaptation of vital organizations and their high levels in the blood, represented by sodium bicarbonate (Hco3)), which prevents its transformation to acidic, which causes significant changes in chemical and cellular reactions in the bodies of the players, as well as raising the level of molecular pressure of oxygen pO2.) inhaled arterial blood, offset by a decrease in the level of partial pressure of carbon dioxide (pCO2), and thus leads to the occurrence of alkalinity of the blood and maintenance of (pH within normal limits after physical exertion compared to the state of rest, and the explanation was consistent with all previous studies "*training under hypoxia results from changes in arterial blood gases at high levels pO2 (HCO3,) and maintaining the level of (pH pCO2,) after the effort compared to the state of rest*." (Azizi, 2011) & (Putman. 2003) & (Masoumeh Azizi, 2011) and also "*a 10-week hypoxic training program increases the metabolic pathway and (Hco3) to maintain a neutral pH resulting in a reduction in arterial blood pCO2*." (Lippi, 2007) & (Brian. 2006) & (Harward J, 2009)

The researchers also explain these indications also to the method of performance implemented to reduce the percentage of oxygen necessary for tissues and cells voluntarily from the normal level, and as a result of the great effort in muscle fibers, which consume large amounts of oxygen, which requires compensating them in larger quantities as a result of the shortage in their stores in order for the cell to carry out its functional duties and not be exposed to stresses, showing different vital reactions and work adaptations under exceptional circumstances, represented in metabolic efficiency and energy expenditure economy, Thus, muscle glycogen stores increase, and the number of red blood cells carrying oxygen-bound hemoglobin, which increases its percentage in the blood to enhance myoglobin stores of muscle cells and tissues for energy requirements, and this explanation was consistent with all previous studies, which confirmed that "*the implementation of hypoxic training exposes muscle cells to oxygen* *deficiencies, which leads to vital reactions that in turn help in adapting them to work under hypoxic conditions, improve the level of performance of athletes and save energy*." (Dale R. 2015) & (Walter F. 2016) & (M. VOGT, 2001) and also "*hypoxia training improves blood variables, including oxygen saturation, by increasing the number of red cells carrying it*." (Czuba, 2014) & (Mackenzie, 2008) & (Carsten Lundby, 2011) and also "*hypoxic training occurs responses and adaptations to the characteristics of the physiological state in the body, which have become many times the training without the hypoxic method*." (Czuba M, 2011) & (Katayama, 2004) & (Vogt, 2001) & (Zoll, 2006) & (Geiser, 2001) & (Gore, 2001)

4. Conclusions and Recommendations

4.1 Conclusions

1) The results of the measurements of the parameters of arterial blood gases showed that they fall within the normal limits of the members of the research sample.
2) Fitness exercises according to the method of gradient hypoxia significantly affected the raising of the level of gas pressure (Hco3&pO2) in the arterial blood, and the preference was for the experimental group.
3) Fitness exercises according to the method of gradient lack of oxygen significantly affected the inhibition of the level of gas pressure (pCO2) in arterial blood and the preference was for the experimental group.
4) The tests recorded the balance of arterial blood regulation (pH) as a result of fitness exercises according to the method of gradient lack of oxygen, and the preference was the experimental group.
5) The proposed exercise method, by adopting the hypoxic device of the experimental group, achieved superiority over the traditional methods of training used by the control group in the parameters of arterial blood gases.

4.1 Recommendations

1) Adopting fitness exercises according to the method of gradient lack of oxygen as an aid in improving the parameters of arterial blood gases.
2) Adopting the measurement of arterial blood gas parameters as indicators in the level of adaptation of the functional organs and systems of the players.
3) The need to use modern training devices and tools that serve the functional aspects, including the hypoxic device (training mask) because of its positive impact on the process of improving the measurement of arterial blood gas parameters and their positive reflection on the aspects of the physical condition.
4) Conducting periodic medical examinations during the training stages as a criterion to confirm the health status of athletes.
5) Conducting similar studies on other physiological variables in multiple sports events and on different age groups and for both sexes.

Conflict of Interest Statement
The authors declare that this research had been conducting without any financial or commercial relationship may consider as a potential conflict of interest.

About the Author(s)

Mustafa Ghasib Abdulzahra is a Member of the Scientific Committee for Postgraduate Studies; he participated in many scientific conferences and seminars, Iraq.
Institutional webpage: https://systems.uomisan.edu.iq/cv/staff/details/538
ResearchGate: https://www.researchgate.net/profile/Mustafa-Al-Saediy
Muthana Layth Hatem is the Head of Student Activities Division; he participated in many scientific conferences and seminars, Iraq.
Institutional webpage: https://systems.uomisan.edu.iq/cv/staff/details/565
ResearchGate: https://www.researchgate.net/profile/mthny-hatm
Email: muthanna_lath@uomisan.edu.iq

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